

ENCLOSURE 1
RATIONALE FOR EPA’S ACTION ON REVISIONS
TO NORTH DAKOTA WATER QUALITY STANDARDS

This enclosure provides the rationale for EPA’s action on certain revisions to *Standards of Quality for Waters of the State* (Chapter 33-16-02.1) adopted by the North Dakota State Health Council (Council) on April 28, 2010. The revisions were submitted to EPA Region 8 with a cover letter dated June 11, 2010. Receipt of the revisions on June 15, 2010 initiated EPA’s review.

On July 14, 2010 EPA completed a partial action that approved all revisions, with the exception that no action was taken on the: (1) revisions to water quality standards for the Sheyenne River and (2) revisions to certain water quality criteria for reservoirs. Today’s action addresses only the revisions that were not acted upon in EPA’s July 14, 2010 letter. This enclosure provides a summary of the revisions and a rationale for the action taken by EPA.

EPA’s review of the adopted revisions addressed various documents including the information submitted to EPA by the North Dakota Department of Health (Department) as well as other information. In particular, EPA reviewed the supporting analysis prepared by the Department, the public comments that were submitted, and the Department’s response to those comments. For reasons that are discussed below, EPA also reviewed the technical information supporting the sulfate criterion adopted by the State of Illinois.

The documents reviewed by EPA include the following:

- The June 11, 2010 submittal package from the Department including a cover letter and the following attachments:
 - The Attorney General certification dated April 28, 2010
 - The final strike-out copy of Chapter 33-16-02.1 showing the changes to the regulation
 - The Department’s summary of public comments and response to comments
 - *Maximum Sulfate Limit of the Sheyenne River Supporting Analysis*. North Dakota Department of Health. (Attachment I to June 11, 2010 submittal letter)
 - *Health Effects from Exposure to Sulfate in Drinking Water Workshop*. EPA 815-R-99-002. January 1999 (Attachment II to June 11, 2010 submittal letter)
 - *Devils Lake, Sheyenne River, Red River and Lake Winnipeg. Parasite and Pathogen Monitoring Summary of Results*. (Attachment III to June 11, 2010 submittal letter)
 - *Devils Lake Cumulative Exceedance Probabilities Based on USGS Stochastic Simulation Model Runs for 3 Sets of Initial Conditions* (Attachment IV to June 11, 2010 submittal letter)
 - *Final Report. Limited Biota Survey for Devils Lake, ND*. Compiled by Bryan Arroyo. Council on Environmental Quality. (Attachment V to June 11, 2010 submittal letter)
 - *Devils Lake Outlet Discharge Summary of Ambient Water Quality Sampling Program* (Attachment VI to June 11, 2010 submittal letter)

- *Finding and Statement of Reason of the North Dakota Department of Health Regarding Proposed Rule Relating to Water Quality Standards* (Attachment VII to June 11, 2010 submittal letter)
- *Stochastic Simulations of Effects of 250 Cubic Feet Per Second Devils Lake Outlet on Sulfate Concentrations in the Sheyenne River*. Devils Lake Outlet Monitoring Committee. Modeling Subcommittee Meeting. March 3, 2010. (Attachment VIII to June 11, 2010 submittal letter)
- *Monitoring and Modeling the Effects of Proposed Increase in Devils Lake Outlet Capacity on Future Flows and Sulfate Concentrations in the Upper Sheyenne River and Lake Ashtabula*. USGS Progress Report. (Attachment IX to June 11, 2010 submittal letter)
- Copies of all public comments submitted to North Dakota during the State’s rulemaking process (including both the July 15, 2009 and December 22, 2009 rulemaking proposals)
- March 16, 2010 letter from Dwight Williamson, Assistant Deputy Minister, Manitoba Water Stewardship, Ecological Services Division, to Carol Rushin, Acting Regional Administrator, U.S. EPA Region 8.
- *Sources and Processes Affecting Dissolved Sulfate Concentrations in the Upper Sheyenne River*. W.M. Schuh and M.H. Hove. March 22, 2006
- Several of the documents pertaining to the Illinois aquatic life sulfate criterion including:
 - March 19, 2009 letter from Tinka G. Hyde, Director, Water Division, EPA Region 5, to Marcia T. Willhite, Chief, Bureau of Water, Illinois Environmental Protection Agency, approving the revised Illinois criteria for sulfate and total dissolved solids.
 - *Facts in Support of Changing Water Quality Standard for Sulfate, Total Dissolved Solids and Mixing Zones*. (Illinois Submittal Exhibit B)
 - *Sulfate and TDS water quality standards of neighboring states*. (Illinois Submittal Exhibit D)
 - *Literature toxicity considered valid for standard derivation*. (Illinois Submittal Exhibit M)
 - Mount et al. 1997 (Illinois Submittal Exhibit O)
 - *Sulfate toxicity data from research conducted by Dr. Soucek*. (Illinois Submittal Exhibit P)
- More recent literature and memorandums with sulfate toxicity data for aquatic life including Soucek (2007a), Soucek (2007b), and Soucek (2010).
- August 20, 2010 letter from Robert. R. White, Office of the State Engineer, Water Appropriation Division, to Michael Sauer, North Dakota Department of Health.

The discussion below identifies the changes to *Standards of Quality for Waters of the State* (Chapter 33-16-02.1) and EPA’s rationale for action. The discussion is organized as follows:

- I. 33-16-02.1-09(1)(b) and Appendix I – Municipal/Domestic Use Removal for the Upper Portion of the Sheyenne River
- II. 33-16-02.1-09(3)(b) – Revision to the Sulfate Criterion for the Upper Portion of the Sheyenne River
- III. 33-16-02.1-09(3)(e) – Revisions to Certain Water Quality Criteria For Reservoirs

I. 33-16-02.1-09(1)(B) AND APPENDIX I – MUNICIPAL/DOMESTIC USE REMOVAL FOR THE UPPER PORTION OF THE SHEYENNE RIVER

The Department adopted a site-specific change to the designated uses for the Sheyenne River. The revision removes the municipal and domestic water supply use for the reach of the Sheyenne River extending from its headwaters to 0.1 mile downstream from Baldhill Dam. The designated use removal is evident from the revisions to 33-16-02.1-09(1)(b) and Appendix I. For the same reach of the Sheyenne River, the Department also revised the sulfate criterion from 450 mg/L (as a 30-day average concentration) to 750 mg/L (as a maximum allowable concentration). The revision to the sulfate criterion is discussed in Section II of this enclosure.

EPA’s review addressed whether the revision complies with the requirements of EPA’s water quality standards regulation at Section 131.10(a), Section 131.10(b), and Section 131.10(g).

40 CFR Section 131.10(a)

Section 131.10(a) of EPA’s water quality standards regulation requires that:

“Each State must specify appropriate water uses to be achieved and protected. The classification of the waters of the State must take into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish and wildlife, recreation in and on the water, agricultural, industrial, and other purposes including navigation” (underline added).

The Section 131.10(a) requirement does not preclude removal of water supply designated uses; rather, it provides States with flexibility and discretion to decide whether use removal is appropriate on a segment-by-segment basis, provided the State decision also complies with the additional requirements discussed below. Regarding the upper reach of the Sheyenne River, EPA believes the Department considered the use and value of the water, and concluded that because there are no current or planned diversions for water supply, it is appropriate to remove the municipal and domestic water supply designated use. EPA believes the State’s decision is reasonable. Accordingly, EPA concludes the decision to remove the municipal and domestic water supply use from the upper reach of the Sheyenne River complies with 40 CFR Section 131.10(a).

40 CFR Section 131.10(b)

Section 131.10(b) of EPA’s water quality standards regulation requires that:

“In designating uses of a water body and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters” (underline added).

EPA’s interpretation of this requirement is that where water supply is a designated use for a downstream segment, Section 131.10(b) does not necessarily mandate that the same use must also be designated for upstream segments. Section 131.10(b) specifically references that the State shall ensure that its “water quality standards” provide for the attainment and maintenance of downstream standards. The term “water quality standards” is defined at 40 CFR Section 131.3(i) as follows:

“Water quality standards are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the Act.” 40 CFR Section 131.3(i).

Given that water quality standards consist of a designated use or uses and water quality criteria, EPA believes Section 131.10(b) can be addressed by establishing an appropriate narrative and/or numeric water quality criterion for upstream segments that provides for the attainment and maintenance of the water quality standards of downstream waters. This approach allows for designation of uses on a segment-by-segment basis. EPA believes this approach is one option for complying with 40 CFR Section 131.10(b).

Protection of downstream water quality standards is a legitimate concern largely because there are downstream sulfate criteria more stringent than the revised 750 mg/L sulfate criterion adopted for the upper reach of the Sheyenne River. For example, in the lower reach of the Sheyenne River, the effective North Dakota sulfate criterion for purposes of the CWA is 450 mg/L as a 30-day average.¹ Further downstream, in the Red River, the effective North Dakota sulfate criterion for CWA purposes is 250 mg/L as a 30-day average.² These downstream criteria were not revised in the just-completed State rulemaking, but both criteria are more stringent than the 750 mg/L criterion adopted for the upper reach of the Sheyenne River. EPA notes that, to protect uses of the Red River, the State of Minnesota has adopted a 250 mg/L sulfate criterion and a 500 mg/L total dissolved solids (TDS) criterion.³ In addition, Red River water quality objectives for sulfate (250 mg/L) and TDS (500 mg/L) have been established by the International Joint Commission at the boundary between the United States and Canada pursuant to Article IV of the Boundary Waters Treaty of 1909.

¹ Although EPA has issued a 250 mg/L “secondary maximum contaminant level” (or SMCL) for sulfate pursuant to the Safe Drinking Water Act (SDWA), for purposes of achieving compliance with CWA requirements (including the 40 CFR Section 131.10(b) requirement) the effective sulfate criterion in the lower reach of the Sheyenne River is the 450 mg/L Class IA sulfate criterion. SMCLs are non-enforceable SDWA guidelines that assist public water systems in managing their drinking water for aesthetic considerations (e.g., taste), but are not effective for CWA purposes unless adopted by a State as an ambient criterion to protect designated uses.

² The Sheyenne River (a Class IA stream) is a tributary to the Red River (a Class I stream). One of the differences between these two stream classifications is that the Class I sulfate criterion (250 mg/L) is more stringent than the Class IA sulfate criterion (450 mg/L).

³ TDS is a measure of inorganic salts and organic matter in water that pass through a filter including e.g., calcium, magnesium, sodium, and potassium cations and carbonate, chloride, sulfate, and nitrate anions.

The Department addressed the Section 131.10(b) requirement by adopting a new narrative criterion to protect downstream waters:

“The water quality standards for the Red River and portions of the Sheyenne River located downstream from the segment of the Sheyenne River to which the Site-Specific Sulfate Standard applies must continue to be maintained. The Sheyenne River from 0.1 mile downstream from Baldhill Dam to the confluence with the Red River shall not exceed 450 mg/L sulfate (total) 30 day arithmetic average and the Red River shall not exceed 250 mg/L sulfate (total) 30 day arithmetic average after mixing, downstream from the confluence of the Sheyenne River. Regulated pollution control efforts must be developed to achieve compliance with these water quality standards” (underline added).

By adopting this narrative criterion, EPA believes North Dakota has provided for the attainment and maintenance of the water quality standards of downstream waters including, for example, the Red River water quality standards adopted by Minnesota. In particular, EPA views the first sentence of the criterion (underlined above), as broadly protecting the water quality standards of downstream waters consistent with 40 CFR Section 131.10(b).

EPA recognizes and understands that Sheyenne River water quality (e.g., sulfate) is affected by the Devils Lake outlet.⁴ However, the State has established a program to monitor ambient water quality conditions upstream and downstream of the outlet in the Sheyenne and Red Rivers (Attachment VI to June 11, 2010 submittal letter). Sheyenne River samples are collected near Flora (upstream of the outlet), the outlet itself, and downstream of the outlet near Bremen, near Warwick, near Cooperstown, and below Baldhill Dam (i.e., below Lake Ashtabula).⁵

Monitoring has demonstrated that for some periods the outlet increases sulfate concentrations in the river, and that sulfate concentrations diminish with distance from the outlet. For April 2008 to June 2010, sulfate concentrations in the outlet itself averaged 644 mg/L, and mean sulfate concentrations at Flora, Bremen, Warwick, Cooperstown and below Baldhill Dam were 327 mg/L, 409 mg/L, 331 mg/L, 286 mg/L, and 237 mg/L, respectively, with maximum values at 547 mg/L, 693 mg/L, 590 mg/L, 421 mg/L, and 405 mg/L. In addition, because a higher percentage of river flow is contributed by the outlet during low flow conditions, higher sulfate concentrations are observed during low flow conditions. The monitoring program will allow the State to identify when pollutant concentrations rise to levels that threaten non-compliance with downstream standards. In addition, water quality modeling work that has been completed will help the State predict when downstream standards are likely to be exceeded (Attachment VIII and IX to June 11, 2010 submittal letter).

⁴ The Devils Lake outlet transfers water from Devils Lake to the Sheyenne River to relieve flooding in the Devils Lake basin. The outlet is operated intermittently. For example, it has been shut down during winter and when necessary to attain downstream water quality standards.

⁵ The municipal and domestic water supply use is designated in the lower reach of the Sheyenne River beginning at a point 0.1 mile below Baldhill Dam.

These tools provide the State with adequate information for use in determining when non-compliance with downstream standards is at risk. EPA believes the State will have all of the information needed to operate the Devils Lake outlet in a manner that complies with water quality standards.

Because the State adopted a narrative criterion that provides for the attainment and maintenance of the water quality standards of downstream waters, EPA concludes that the site-specific revisions to water quality standards for the Sheyenne River comply with 40 CFR Section 131.10(b).

40 CFR Section 131.10(g)

Finally, because a designated use was removed, the Section 131.10(g) requirement must be met:

“States may remove a designated use which is not an existing use, as defined in § 131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible...”

In other words, to be consistent with the Section 131.10(g) requirement, the information supporting removal of a designated use must demonstrate that: (1) the use is not an existing use, and (2) attaining the designated use is not feasible.

In support of the decision to remove the municipal and domestic water supply use, the Department’s analysis (Attachment I to the Department’s June 11, 2010 submittal letter) reports that there are no municipal, rural water district, or industrial uses, and that the Department is not aware of plans, preliminary plans or intent in using the Sheyenne River in this reach for these purposes. This conclusion is supported by a September 2, 2009 memorandum (attachment to the Department’s analysis) from D. Wayne Kern, P.E., Director, Division of Municipal Facilities, which stated:

“Presently, there are no public water systems (PWSs) that use the Sheyenne River upstream of Lake Ashtabula as a drinking water source. I am also not aware of any plans on the part of PWSs to utilize this stretch of the Sheyenne River as a drinking water source.”

In addition, the Department’s analysis reports that the North Dakota State Water Commission has not received any applications for water appropriation permits on this reach of river. An appropriation of greater than 12.5 acre feet of water requires a permit.

Finally, an August 20, 2010 letter from Robert. R. White, Office of the State Engineer, Water Appropriation Division to Michael Sauer, North Dakota Department of Health contained the following information:

“Specifically, you asked if any appropriation permits had been issued for municipal or domestic use from the Sheyenne River since 1975, with a point of diversion located in the reach of river that extends from the headwaters to 0.1 mile downstream of Baldhill Dam.

You also asked if any existing appropriation permits been utilized in the same reach of the river since 1975.

The answer to both questions is no. There has been no municipal or domestic use from the Sheyenne River since 1975.”

Based on review of the information received, including all public comments, EPA is not aware of any evidence of actual (on or after November 28, 1975) or planned diversions for water supply purposes in the portion of the Sheyenne River where the municipal and domestic designated use was removed. However, EPA does understand and acknowledge that there are actual or potential diversions in the downstream reach, where no revisions to water quality standards were adopted.

EPA’s view is that the information submitted by the Department adequately demonstrates that municipal and domestic water supply is not an existing use in the reach where the designated use was removed. Although there are municipal and domestic existing uses in the downstream reach, EPA believes this situation does not preclude North Dakota from removing the designated use from the upstream reach as long as the requirement to meet downstream water quality standards is in place.

The Department’s supporting analysis also presents information regarding natural water quality conditions, as a basis for concluding that it is not feasible to attain the 450 mg/L sulfate criterion that protects the municipal and domestic water supply use (40 CFR Section 131.10(g)(1)). The Department’s supporting analysis explains that:

“The Sheyenne River sulfate concentrations are largely influenced by natural conditions. Runoff from precipitation and snow melt generally decrease sulfate concentrations whereas low flows are dominated by groundwater discharge. Groundwater is more mineralized and contains much higher sulfate concentrations.”

To support the conclusion that natural conditions prevent attainment of the 450 mg/L sulfate criterion, the Department’s supporting analysis discusses sulfate concentration data for the Flora site. The analysis notes that the Flora site is located in a portion of the river where sulfate concentrations are largely the result of natural conditions (e.g., it is located upstream of the Devils Lake outlet). Regarding water quality conditions at the Flora site, the Department’s supporting analysis includes the following:

“From 2005 to present; 565 samples were taken at the Flora site. Of these 167 had a higher sulfate concentration than 450 mg/L; 80 had a higher concentration than 600 mg/L; 45 had a higher concentration than 700 mg/L; and 42 had a higher concentration than 750 mg/L.”

Because 167 of 565 (or 30%) of Sheyenne River samples at the relatively undisturbed Flora site exceed 450 mg/L, the Department’s analysis concludes a sulfate criterion of 450 mg/L is “inappropriate.”

EPA Region 8 considered how sulfate concentrations vary spatially in the upper reach, and concluded that sulfate concentrations generally diminish with distance downstream. This topic was discussed in *Sources and Processes Affecting Dissolved Sulfate Concentrations in the Upper Sheyenne River* (Schuh and Hove, 2006) which reports that for the periods 1992-1999 and 2000-2005, mean sulfate concentrations at the Warwick gage (downstream of Flora) were 53% and 57% of those at the Harvey gage (upstream of Flora), respectively. For example, during 2000-2005, mean sulfate concentrations at Warwick and Harvey were 212 mg/L and 370 mg/L, respectively. Similarly, during 2000-2005, maximum concentrations observed at Warwick and Harvey were 307 mg/L and 610 mg/L, respectively.

No public comments were submitted contesting the conclusion that there are locations in upper reach where naturally occurring pollutant concentrations prevent attainment of the 450 mg/L sulfate criterion.

EPA believes it is reasonable for the State to conclude that attainment of the Class IA 450 mg/L sulfate criterion is prevented by natural conditions. Although sulfate concentrations vary spatially in the reach, the Region agrees that there are multiple locations where exceedances of the 450 mg/L Class IA sulfate criterion have been documented and it is reasonable to conclude exceedances are largely the result of natural conditions.

Because the supporting information adequately demonstrates that municipal and domestic water supply is not an existing use, and that attainment of the sulfate criterion is prevented by natural conditions, EPA believes the decision to remove the municipal and domestic water supply designated use complies with 40 CFR Section 131.10(g).

Conclusion

EPA has determined that removal of the municipal/domestic use for the upper portion of the Sheyenne River is a reasonable exercise of the State’s discretion and that it complies with relevant federal requirements, including 40 CFR Section 131.10(a), 131.10(b) and 131.10(g). Accordingly, the revisions to 33-16-02.1-09(1)(b) and Appendix I are approved.

II. 33-16-02.1-09(3)(B) – REVISION TO THE SULFATE CRITERION FOR THE UPPER PORTION OF THE SHEYENNE RIVER

The Department adopted a revised sulfate criterion for the reach of the Sheyenne River extending from its headwaters to 0.1 mile below Baldhill Dam. A 750 mg/L sulfate criterion (expressed as a not-to-be-exceeded maximum value) was adopted, replacing the previous 450 mg/L Class IA sulfate criterion (expressed as a 30-day average value). The site-specific criterion was added to Section 33-16-02.1-09(3)(b), as follows:

Site-Specific Sulfate (total) Standard

The following site-specific standard applies to the Sheyenne River from its headwaters to 0.1 mile downstream from Baldhill Dam.

<u>Sulfate (Total)</u>	<u>750 mg/L</u>
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EPA reviewed whether the revision to the sulfate criterion complies with the requirements of EPA’s water quality standards regulation. In particular, our review addressed whether the State’s action complies with the regulatory requirement found at 40 CFR Section 131.11(a)(1). Because sulfate is the only parameter where a revised or new water quality criterion was adopted, EPA’s review focused on sulfate, and whether the revised criterion complies with Section 131.11(a)(1).⁶ Note that the Section 131.10(b) requirement to provide for the attainment and maintenance of the water quality standards of downstream waters is discussed above in Section I.

40 CFR Section 131.11(a)(1) requires that:

“States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.”

For the upper reach of the Sheyenne River, the municipal and domestic water supply use was removed (see above discussion in Section I). Accordingly, EPA’s review addressed whether the 750 mg/L criterion will protect the (still designated) aquatic life and agriculture uses based on sound scientific rationale. The reasoning in support of EPA’s conclusion is presented below, with aquatic life and agriculture use protection addressed separately.

⁶ Pursuant to CWA Section 303(c)(3), EPA’s authority to review and approve or disapprove State adopted water quality standards is limited to “revised or new” standards.

Aquatic Life Use

The Supporting Analysis Submitted by the North Dakota Department of Health

To help evaluate whether a criterion is protective of aquatic life, it is common practice to compare the criterion to aquatic life criteria recommendations issued by EPA pursuant to CWA Section 304(a). For sulfate, EPA has not issued any CWA § 304(a) criteria recommendations. However, various States have reviewed the available toxicological information and adopted sulfate criteria to protect designated uses based on sound scientific rationale. For example, EPA Region 5 received a revised sulfate criterion from the State of Illinois on December 9, 2008 and approved the criterion with a March 19, 2009 action letter.

Because it was recently approved by EPA, the Department used the Illinois criterion as a benchmark to help demonstrate that its proposed Sheyenne River sulfate criterion is protective of aquatic life. Because the Illinois criterion is expressed as a function of hardness and chloride, the Department used hardness and chloride concentrations in samples taken from April 2008 to July 2009 at five Sheyenne River locations (Flora, Bremen, Cooperstown, below Baldhill Dam, and the Devils Lake outlet) to calculate benchmark values for comparison to the proposed 750 mg/L Sheyenne River criterion. The results were presented in the Department’s supporting analysis (Attachment I to June 11, 2010 submittal letter). This comparison indicated that for each of the samples at the five locations (a total of 174 individual samples) the proposed 750 mg/L standard was always more stringent than the Illinois criterion. Based on this comparison, the Department’s supporting analysis concluded that:

“The Illinois method for determining permissible sulfate concentrations supports our conclusion that 750 milligrams per liter sulfate (total) is not only protective but more than adequate to protect aquatic life.”

The Illinois Criterion is Protective of Aquatic Life

Regarding the Illinois criterion, the March 18, 2009 rationale included with EPA Region 5’s action letter noted that:

“EPA’s review consisted of determining whether or not the data gathered and generated by Illinois were acceptable, whether or not the data satisfied EPA’s minimum data requirements for deriving a water quality criterion, whether or not the criterion derived by Illinois is scientifically defensible, and whether or not the criterion will protect the uses of Illinois surface waters. Based on this review of the data gathered and generated by Illinois and the criterion derived from the data, EPA concludes that the new Illinois sulfate criterion...is sufficient to protect the uses of Illinois surface waters...”

EPA Region 8 reviewed the technical rationale developed by the State of Illinois and submitted to EPA Region 5. Key points supporting a conclusion that the Illinois criterion is appropriate for the protection of aquatic life include the following:

- The criterion was developed based on a compilation of toxicity test results, and the compilation was not restricted to aquatic species found in Illinois surface waters.
- Illinois coordinated additional aquatic life toxicity tests on key invertebrate species including *Ceriodaphnia dubia*, planktonic crustacean, *Hyalella azteca*, benthic crustacean, *Chironomus tentans*, aquatic insect, *Spharium simle*, a fingernail clam and *Lapsilis siliquoidea*, a freshwater mussel.
- The criterion was derived to protect the two most sensitive species in the dataset, *Hyalella azteca* and *Ceriodaphnia dubia*. Both of these species are known to be sensitive to a wide range of pollutants.
- The criterion was developed to be protective of Illinois surface waterbodies on a statewide basis, rather than a particular waterbody type.
- The toxicity dataset was limited to Na₂SO₄ exposures since water quality data show that sodium is the predominant cation in Illinois waters and sodium generally increases with sulfate concentration. Similar trends in water quality are observed in the Sheyenne River (Figures 1 and 2).
- Illinois coordinated closely with EPA when developing the criterion and received technical assistance from the Mid-Continent Ecology Division of EPA’s Office of Research and Development.
- Illinois did not derive a chronic sulfate criterion due to limited toxicity data. Region 8 concurs that insufficient data were available to Illinois to derive a chronic criterion, and that it is appropriate for States to adopt acute criteria in that scenario. For example, EPA has published acute, but not chronic criteria recommendations for some parameters (e.g., silver, aldrin, lindane).

Figure 1 – Sheyenne River cation water quality data collected April 2008 through January 2010. Sites represented include the Flora, Bremen, Warwick, Cooperstown, and Baldhill Dam monitoring locations.

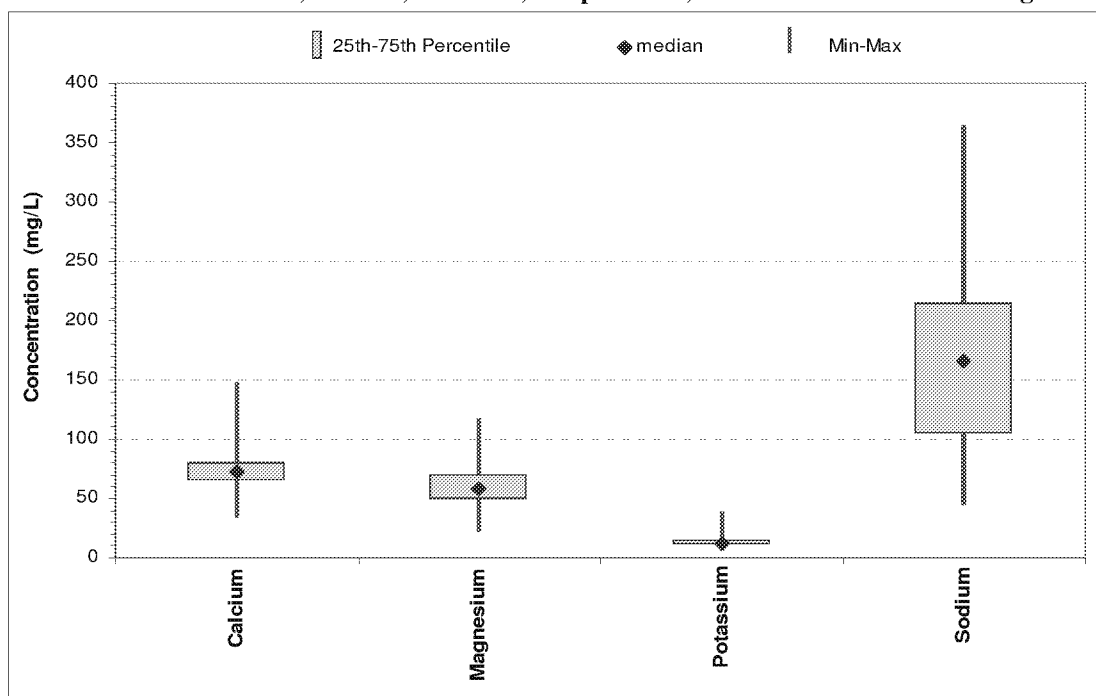
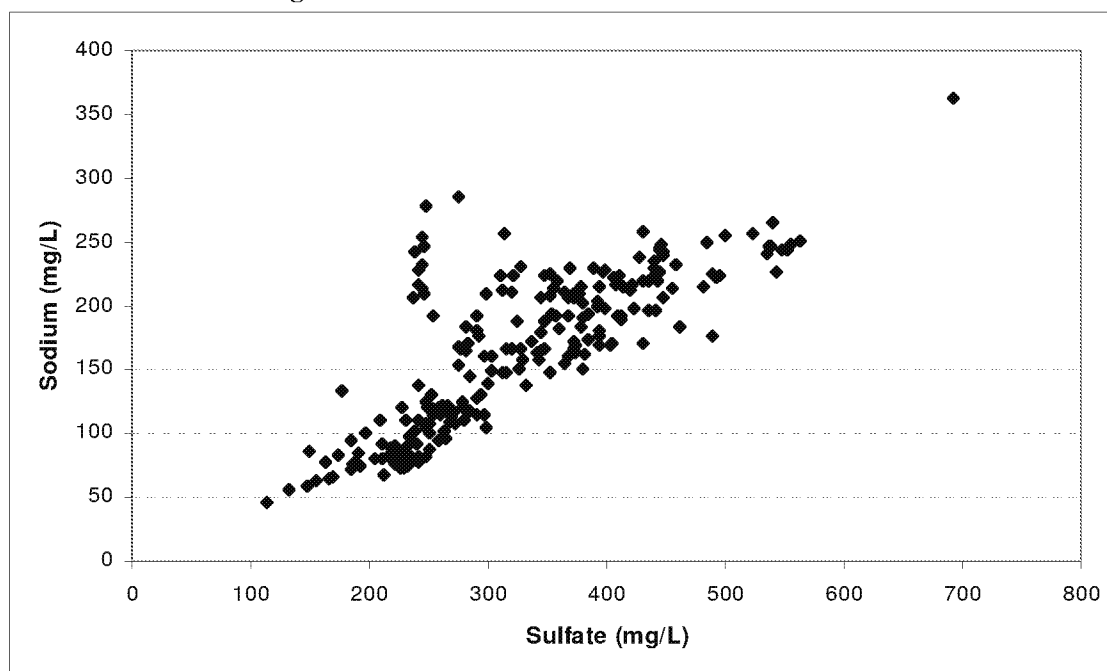


Figure 2 – Co-located sulfate and sodium water quality data for the Sheyenne River. Data represent samples collected April 2008 through Januray 2010 from the Flora, Bremen, Warwick, Cooperstown, and Baldhill Dam monitoring locations.



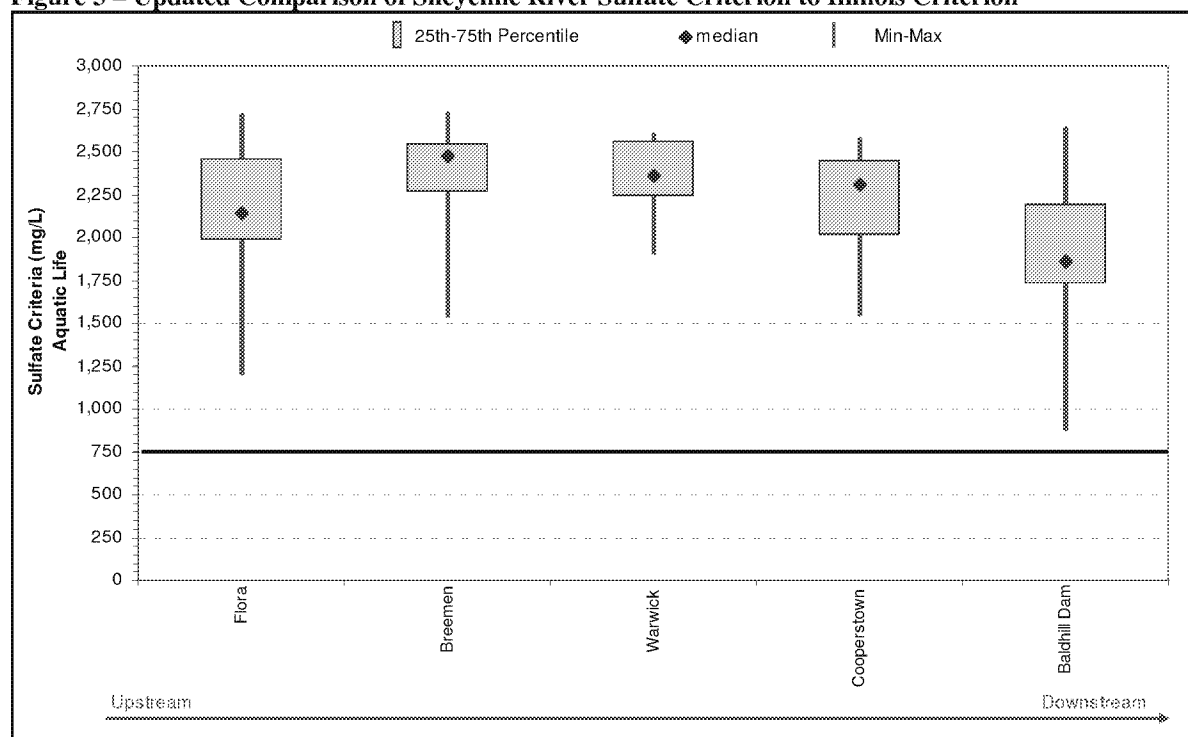
EPA’s Updated Comparison of the North Dakota and Illinois Criteria

EPA Region 8 updated the Department’s comparison with a larger dataset of Sheyenne River samples taken between April 14, 2008 and June 2, 2010. The updated comparison used data for five Sheyenne River locations: Flora, Bremen, Warwick, Cooperstown, and below Baldhill Dam. The updated comparison again indicated that for each of the samples at the five locations (a total of 327 samples) the 750 mg/L criterion was always more stringent (i.e., a lower value) than the Illinois criterion. Further, the 750 mg/L criterion was less than the median benchmark value by a factor that ranged from 2.5 (below Baldhill Dam) to 3.3 (near Bremen). See Table 1 and Figure 3.

Table 1 - Updated Comparison of Sheyenne River Sulfate Criterion to Illinois Criterion.

Sheyenne River Location	Site-Specific Sulfate Criterion (mg/L)	No. of Sheyenne River Samples (n)	Illinois Aq. Life Criterion (mg/L) Minimum Calculated Benchmark Value*	Illinois Aq. Life Criterion (mg/L) Median Calculated Benchmark Value*
Flora	750	70	1207	2144
Near Bremen	750	69	1545	2473
Near Warwick	750	66	1916	2362
Near Cooperstown	750	61	1554	2309
Below Baldhill Dam	750	61	883	1857

* Based on samples taken from April 2008 to June 2010

Figure 3 – Updated Comparison of Sheyenne River Sulfate Criterion to Illinois Criterion

Conclusion Regarding Aquatic Life

EPA's conclusion regarding aquatic life is based on two key points.

- First, the Illinois criterion is protective of aquatic life based on sound scientific rationale. Illinois coordinated new toxicity tests with key invertebrate species and combined the results with previously-available data. The compilation of data was not limited to aquatic species found in Illinois surface waters. Illinois derived its criterion to protect the two most sensitive species in the dataset as a function of hardness and chloride to better reflect the effects of site water chemistry on sulfate toxicity.
- Second, the site-specific 750 mg/L sulfate criterion adopted by North Dakota is more stringent than the Illinois criterion at the hardness and chloride levels in the upper Sheyenne River.

Based on these points, the Region concludes that the 750 mg/L criterion will protect aquatic life uses in the upper reach of the Sheyenne River.

Agriculture Use

Regarding agricultural uses, the Department’s supporting analysis reports that:

“Agriculture use on this reach of the Sheyenne River is mostly livestock watering and a small number of irrigators. North Dakota designates Class III streams as suitable for agriculture use but does not delineate numeric criteria to support that use. Class III streams have a maximum limit of 750 mg/L of sulfate (total) 30-day arithmetic average. The state of Illinois has numeric limits of 2,000 mg/L of sulfate for livestock watering. North Dakota State University Extension suggests that concentration of 1000 mg/L to 1500 mg/L is protective for most classes of grazing livestock.”

EPA has not developed criteria recommendations for protection of agricultural uses. Similarly, many States have not adopted sulfate water quality criteria for protection of agricultural uses. However, State sulfate criteria for protection of agriculture generally are less stringent than 750 mg/L (Table 2).

Table 2 – State-Adopted Sulfate Criteria for Protection of Agriculture Uses

State	Sulfate Criterion (mg/L)
Illinois	2000
Kansas	1000 (livestock watering)
Minnesota	1000 (to protect young cattle) 10 (to protect wild rice)
Utah	2000 (site-specific, livestock watering)

Sulfur is an essential nutrient that can become toxic when consumed at concentrations above the necessary amount. Ruminants are the most likely species to develop sulfur toxicosis due to the generation of hydrogen sulfide gas in the rumen (NRC 2005). When inhaled, hydrogen sulfide gas can result in central nervous system disruption. Toxic effects observed in cattle that have consumed too much sulfur also include diarrhea, decreased growth, water intake and food intake, interference with micronutrient, and polioencephalomalacia.

The 750 mg/L sulfate criterion is near the lower end of the range of concentrations recommended for protection of livestock watering (Table 3). Although the adopted criterion exceeds some recommendations, EPA believes it is reasonable to conclude that a criterion limiting sulfate concentrations to a maximum value of 750 mg/L will be protective of livestock. EPA estimated the total sulfur dose when sulfate in water is equal to 750 mg/L by using methods outlined by Gould (2000)⁷ and compared results to the National Research Council (2005) recommended maximum tolerable dose (MTD). For sulfur, the recommended MTD for cattle ranges from 0.3% to 0.5% of the total diet and varies with the percent of the diet that is forage. For a 600 pound animal, if the sulfur content in feed is less than 0.2% and the water sulfate

⁷ Methods in Gould (2000) are summarized in an online calculator available at <http://dlab.colostate.edu/webdocs/tools/calculator.htm>

concentration is 750 mg/L, the total sulfur dose for lactating cows is less than 0.35% at temperatures up to 90°F, and less than 0.30% at temperatures up to 40°F. Temperature and lactation are important considerations because they influence water consumption rates and therefore the total sulfur dose. As temperature decreases, cattle can tolerate a greater concentration of sulfate in water due to decreased water consumption. Furthermore, a lactating cow will consume more water than a non-lactating cow. Because the estimated dose is consistent with the recommended MTD, EPA concludes that the 750 mg/L sulfate criterion is protective of livestock watering.

Table 3 - Maximum recommended levels of sulfate to protect livestock watering.

Source	Sulfate Concentration (mg/L)	Notes
Loneragan et al 2001	583	Feedlot steers fed high-concentrate and high-nonprotein-N diets
MSU undated	2500-3500	very laxative; not recommended for pregnant or lactating cows, cattle in confinement, horses, or sheep; 4,500 mg/L not recommended for use under any circumstances
NRC 2005	2500	Safe for ruminants fed diets with at least 40% forage
Patterson and Johnson 2003	500-1500	Generally safe but may reduce performance in confined cattle
	1500-3000	Marginal quality. May be considered poor for confined cattle during hot weather
Raisbeck et al. undated ⁸	1000	Should not result in loss in performance
	1800	Should minimize the possibility of acute death
SDSU/USDA 2004	1500-2500	No harmful effects expect some temporary diarrhea
USDA/NRCS 2003	500	Limit to maintain production
	1000	Upper limit
USU 1997	1000	Adult cattle
	500	Calves
Weeth and Capps 1972	1450	tolerance level for growing cattle during summer months fed a hay diet

Conclusion

The Region has determined that the 750 mg/L sulfate criterion adopted for the upper reach of the Sheyenne River is protective of aquatic life and agriculture uses, and consistent with the federal requirement to adopt water quality criteria based on sound scientific rationale (40 CFR Section 131.11(a)(1)). Accordingly, the revision to 33-16-02.1-09(3)(b) is approved.

⁸ This study was the basis for North Dakota State University (NDSU 2008) recommendations for safe level of potentially toxic contaminants in water for livestock.

III. 33-16-02.1-09(3)(E) – REVISIONS TO CERTAIN WATER QUALITY CRITERIA FOR RESERVOIRS

Summary of EPA’s Action

Today EPA is disapproving the revision to 33-16-02.1-09(3)(e) providing that reservoirs located on Class IA, Class II, or Class III streams shall have the parameter limitations for that class stream. The basis for EPA’s disapproval is that the revision does not comply with 40 CFR Sections 131.6 and 131.11(a)(1).

Rationale for EPA’s Disapproval

On April 28, 2010, the North Dakota State Health Council adopted a revision to 33-16-02.1-09(3)(e) providing that reservoirs located on Class IA, Class II, or Class III streams shall have the parameter limitations for that class stream. Previously, 33-16-02.1-09(3)(e) applied the criteria for Class I streams to all reservoirs, including reservoirs located on Class IA, Class II, or Class III streams. The criteria affected by the revision are the chloride, sulfate, and sodium criteria for reservoirs located on Class IA, Class II, and Class III streams, and the pH criterion for reservoirs located on Class II and Class III streams. North Dakota’s stream criteria for these parameters are listed in Table 4.

Table 4 - Chloride, Sulfate, Sodium and pH Criteria for Class I, IA, II, and III Streams

Stream Class	Chloride	Sulfate	Sodium	pH
Class I	100 mg/L	250 mg/L	50% of total cations as mEq/L	7.0 – 9.0
Class IA	175 mg/L	450 mg/L	60% of total cations as mEq/L	7.0 – 9.0
Class II	250 mg/L	450 mg/L	60% of total cations as mEq/L	6.0 – 9.0
Class III	250 mg/L	750 mg/L	60% of total cations as mEq/L	6.0 – 9.0

EPA reviewed whether the revision to 33-16-02.1-09(3)(e) complies with the requirements of EPA’s water quality standards regulation. In particular, our review addressed whether the State’s action complies with the regulatory requirements found at 40 CFR Section 131.6 and 131.11(a)(1). These sections of EPA’s regulation require that:

“The following elements must be included in each State’s water quality standards submitted to EPA for review:...(b) Methods used and analyses conducted to support water quality standards revisions, (c) Water quality criteria sufficient to protect the designated uses...”
40 CFR Section 131.6

and

“States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain

sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.”
40 CFR Section 131.11(a)(1)

EPA’s review has identified several problems with the State’s response to these requirements, as follows:

- The Department did not review the literature to see if new scientific information is available regarding the levels of chloride, sulfate, sodium and pH that are protective of designated uses in reservoirs located on Class IA, Class II, and Class III streams.
- The Department did not identify any references to documents that contain a scientific rationale for the revised criteria.
- The Department did not prepare or submit to EPA a supporting analysis as required by 40 CFR Section 131.6.

For chloride and sodium, no information was made available for public review or included in the submittal to EPA demonstrating that the criteria for Class IA, Class II, and Class III streams will protect the designated uses of the reservoirs located on those streams.

For sulfate, no information was made available for public review or included in the submittal to EPA demonstrating that the 450 mg/L criterion for Class IA and Class II streams or the 750 mg/L criterion for Class III streams will protect the designated uses of the reservoirs located on those streams. EPA notes that the 750 mg/L site-specific criterion adopted for the upper Sheyenne River was supported by a site-specific analysis that included evaluation of how the toxicity of sulfate is affected by chloride and hardness levels at the site, but that no such analysis was developed to justify revising the sulfate criteria for all reservoirs located on Class IA, Class II, or Class III streams.

For pH, no information was made available for public review or included in the submittal to EPA demonstrating that the criterion for Class II and Class III streams will protect the designated uses of the reservoirs located on those streams. In addition, EPA is concerned that North Dakota’s Class II and Class III stream criterion (6.0 to 9.0) may not be protective of aquatic life. EPA’s nationally recommended criterion for pH is a range from 6.5 to 9.0. Based on information available to EPA, it is not clear that aquatic life in North Dakota streams or reservoirs would be protected by pH levels below 6.5, as allowed by North Dakota’s criterion for Class II and Class III streams.

The rationale for EPA’s pH criteria recommendation (6.5 to 9.0) is provided in *Quality Criteria for Water 1976* (the Red Book).⁹ The Red Book notes that pH is an important factor in the chemical and biological systems of natural waters, and that the toxicity of many compounds (e.g., hydrogen cyanide, metals, ammonia) is affected by pH. In its review of the effects of pH on

⁹ <http://www.epa.gov/waterscience/criteria/library/redbook.pdf>

aquatic life, the Red Book discusses a 1973 Mount study¹⁰ which casts doubt on the defensibility of North Dakota’s pH criterion for Class II and Class III streams:

“Mount (1973) performed bioassays on the fathead minnow, Pimephales promelas, for a 13-month, one generation time period to determine chronic pH effects. Tests were run at pH levels of 4.5, 5.2, 5.9, 6.6, and a control of 7.5. At the two lowest pH values (4.5 and 5.2) behavior was abnormal and the fish were deformed. At pH values less than 6.6, egg production and egg hatchability were reduced when compared with the control. It was concluded that a pH of 6.6 was marginal for vital life functions.”

The Mount study observed adverse effects at pH values less than 6.6, including reduced egg production and hatchability. Thus, it is not clear that a criterion allowing pH levels as low as 6.0 is adequately protective of aquatic life.

Because the Department did not submit to EPA a supporting analysis or otherwise demonstrate that the revised criteria for chloride, sulfate, sodium, and pH are protective of designated uses based on sound scientific rationale, and because of data which cast doubt on the pH criterion for Class II and Class III streams, the revision to 33-16-02.1-09(3)(e) is disapproved.

The 2000 “Alaska” Rule and the WQS in Effect for CWA Purposes

On March 30, 2000, EPA revised 40 CFR Section 131.21, which is the section of the water quality standards regulation specifying when new and revised State and Tribal water quality standards become effective for CWA purposes (65 Fed. Reg. 24641 (April 27, 2000)).¹¹ Pursuant to these revisions to the regulation (also known as the “Alaska Rule”) new and revised standards submitted to EPA after May 30, 2000 must be approved by EPA before becoming effective for CWA purposes.¹² The final rule also provides that standards already in effect and submitted to EPA by May 30, 2000 may be used for CWA purposes, whether or not approved by EPA.

Consistent with 40 CFR Section 131.21, as revised by EPA on April 27, 2000, the North Dakota water quality standards for reservoirs that were in effect prior to the Council’s April 28, 2010 decision - including the Class I stream criteria for chloride, sulfate, sodium, and pH - are still in effect for CWA purposes. Because of this, the Agency is not aware of any reason for EPA to initiate promulgation of replacement federal standards.

Because the revision to 33-16-02.1-09(3)(e) is disapproved, Class I stream criteria will continue to apply to all reservoirs in North Dakota unless: (1) EPA revises its action (e.g., based

¹⁰ Mount, D.I., 1973. *Chronic effect of low pH on fathead minnow survival, growth and reproduction*. Water Res., 7:987.

¹¹ As revised, 40 CFR Section 131.21(e) provides that: “A State or authorized Tribe’s applicable water quality standard for purposes of the Act remains the applicable standard until EPA approves a change, deletion, or addition to that water quality standard, or until EPA promulgates a more stringent water quality standard.”

¹² Information regarding the “Alaska Rule” is available at <http://www.epa.gov/waterscience/standards/rules/alaska/>

on submission of additional information), (2) the State adopts revisions that are approved by EPA, or (3) EPA promulgates replacement federal standards pursuant to CWA Section 303(c)(4) and 40 CFR Section 131.22.

Options for Resolving the Disapproval

There are several approaches that can be considered by the Department to resolve the disapproval issue and establish water quality standards that meet CWA requirements:

- Option 1 – Review the available scientific information regarding chloride, sulfate, sodium, and pH levels that will protect designated uses in streams and reservoirs. If this review supports the changes to 33-16-02.1-09(3)(e) adopted by the Council on April 28, 2010, develop a technical document explaining the Department’s analysis and conclusion, provide the public with an opportunity to comment on the document, and submit the document to EPA, along with copies of the public comments and the Department’s response to public comments.
- Option 2 – If the review described above does not support the changes to 33-16-02.1-09(3)(e) adopted by the Council on April 28, 2010, develop a technical document explaining the Department’s analysis and conclusion regarding the appropriate criteria for chloride, sulfate, sodium, and/or pH, and conduct a rulemaking action to revise *Standards of Quality for Waters Of The State*. Under this option, the Department may reconsider whether Class I stream criteria should apply to all reservoirs in the State. In addition, for Class II and Class III streams, the Department should consider whether there is a need to adopt revised pH criteria equal to or more stringent than EPA’s pH criteria recommendation (6.5 to 9.0).
- Option 3 – A combination of Option 1 and 2. For example, if supported by its review of the available scientific information, it may be appropriate for the Department to pursue Option 1 for one parameter or parameters and Option 2 for the remaining parameter or parameters.

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